Main drifts would be concrete-lined, 7.6-meter (25-foot)-diameter tunnels excavated by tunnel boring machines. Rail lines and an overhead trolley system in the main drifts would enable the movement of electric-powered construction and waste package handling vehicles. The East Main drift was excavated as part of site characterization activities but was not lined with concrete. During the operation and monitoring phase, the main drifts would support both subsurface development and waste package emplacement, which would occur simultaneously. Ventilation barriers creating airlocks would separate the emplacement and development sides of the repository, and the ventilation system would maintain the emplacement side at a lower pressure than the development side. This would ensure that any air transfer would be from the development side to the emplacement side.

The flexible design is based on an emplacement drift spacing of approximately 81 meters (266 feet) (DIRS 153849-DOE 2001, Section 2.3.1.1). Emplacement drifts would be 5.5-meter (18-foot)-diameter tunnels connecting the main drifts; they could have steel ribbing. These drifts would be excavated by an electric-powered tunnel boring machine. Remotely operated steel isolation doors at the emplacement drift entrances would prevent unauthorized human access and reduce radiation exposure to personnel.

As noted above, tunnel boring machines would excavate the emplacement drifts and most main drifts. DOE would use other mechanical excavators in areas where tunnel boring machines were impractical (for example, excavating turnouts and small alcoves) or industry-standard drill and blast techniques in limited applications where mechanical excavators were impractical. Ventilation shafts [8.0 meters (26 feet) in diameter] would be excavated from the surface to the repository using mechanical or drill-and-blast techniques. (DIRS 153849-DOE 2001, p. 2-95). Specialized equipment would move excavated rock in the subsurface to the conveyor system that would move the rock to the excavated rock storage area on the surface. During drift excavation, water supplied to the subsurface in pipelines would be used for dust control at the excavation location and along the conveyor carrying excavated rock. Some of the water would be removed from the subsurface with the excavated rock, some would evaporate and be removed in the ventilation air, and the remainder would be collected in sumps near the point of use and pumped to the evaporation pond at the South Portal. DOE could recycle the water discharged to the evaporation pond for surface dust suppression activities. Controls would be established, as necessary, to ensure that water application for subsurface (and surface) dust control would not affect repository performance.

#### 2.1.2.2.2 *Ventilation*

The repository design uses ventilation shafts to provide airflow to the subsurface during construction, emplacement, and performance monitoring. It also provides positive pressure ventilation flow for the construction and development of the repository and negative pressure ventilation flow in the emplacement drifts. Further, the design includes monitoring for radioactive contamination and preventive measures to achieve mitigation against the spread of such contamination. The development side would be isolated from the emplacement side. Table 2-2 lists the number of ventilation shafts and flow rates.

The flexible design uses an emplacement drift forced-air ventilation rate of 15 cubic meters (530 cubic feet) per second in each emplacement drift to control temperatures in the rock between the emplacement drifts, at the drift wall, and at the waste package surface to meet thermal goals. Figure 2-12 shows the general airflow pattern for ventilation of the emplacement drifts under the higher-temperature repository operating mode, using a representative section of a fully developed repository. In the basic ventilation design, fresh air would enter through the surface ends of intake shafts and ramps and would flow to the East and West Mains. From the mains, air would enter the emplacement, performance confirmation, or reserve drifts and flow to exhaust raises near the center of each drift. The exhaust raises would direct the airflow down to the exhaust main, where it would continue to an exhaust shaft and then to the surface.

Fans at the surface ends of the exhaust shafts would provide the moving force for the subsurface repository airflow. The fans would have enough power to exhaust the maximum amount of air required during the emplacement, monitoring, and closure periods. The volume of air moved by the fans would be adjustable to meet cooling requirements as they varied over time. The fans would draw air through the exhaust mains at a rate that ensured that air would always flow into the emplacement drifts from the main drifts, never allowing air to recirculate back to the main drifts.

Ventilation under the higher-temperature repository operating mode would remove at least 70 percent of the heat generated by the waste inventory during the preclosure period (DIRS 153849-DOE 2001, Section 2.1.2.2). The peak ventilation air temperature of 58°C (about 136°F) for a 1.4-kilowatt-per-meter linear thermal load would occur about 10 years into the preclosure period and would decrease thereafter (DIRS 150941-CRWMS M&O 2000, pp. 4-24 to 4-25). This temperature is lower than the exhaust air temperature of many industrial processes, such as powerplants and manufacturing facilities. The peak ventilation air temperature under the lower-temperature repository operating mode would be lower than that described above.

Ventilation requirements for emplacement drifts would vary according to the activities conducted in those drifts. Prior to emplacement, ventilation would provide fresh air and control dust levels to ensure an acceptable environment for construction personnel. During emplacement, ventilation would maintain drift temperatures within an acceptable range for equipment operation.

While DOE was conducting concurrent development and emplacement operations, it would maintain two separate ventilation systems, one for each operational area (development and emplacement). This separation would be accomplished by placing airlocks in the main drifts to ensure physical separation of the air space between the two areas. On the development side, the ventilation system would work under positive pressure, with air forced in through the development intake shaft or the South Ramp through a duct and exhausted through the South Ramp. On the emplacement side, the required ventilation facilities for the commissioned emplacement drifts would be available and operational in their final configuration; the ventilation system would work under negative pressure by drawing air out through the exhaust main (through the exhaust or “hot” side of the exhaust main), and from there through the exhaust shafts.

#### 2.1.2.2.3 *Waste Package Emplacement Operations*

DOE would transport both the waste package and metal emplacement pallet as an integral unit from the Waste Handling Building to the prepared *ground support* in the emplacement drift. The transport of each waste package to the subsurface would start after the loading of a waste package and its emplacement pallet on a bedplate (railcar) transporter in the Waste Handling Building and then into the shielded section of the transporter. At its closed end the transporter would be coupled to a manned primary electric-powered locomotive (trolley). A manned secondary electric-powered locomotive would then be coupled to the transporter at the door end outside the Waste Handling Building (DIRS 153849-DOE 2001, Section 2.3.4.4.1). All waste packages would be transported by trolley underground through the North Ramp and into the emplacement area main drift. On arrival at the emplacement drift, the secondary locomotive would be uncoupled from the transporter, which would then be pushed into the emplacement drift turnout by the primary locomotive and stopped short of the isolation doors and loading dock. The operators would leave, and the locomotive operation would proceed by remote control. The isolation doors would be opened remotely, as would the transporter doors. Under remote control, the primary locomotive would push the waste package transporter into the off-loading dock. The waste package and pallet, seated on the bedplate, would be rolled out of the transporter, under remote control, to stop on the transfer section of the railcar. The remote-controlled gantry would straddle the waste package and pallet, lift the waste package and pallet from the bedplate, and carry them to the designated location in the emplacement drift. The bedplate would be rolled back into the waste package transporter, the transporter doors would be closed, and the transporter would be moved back to the access main drift using the